METAL ON METAL RESURFACING HIP ARTHROPLASTY FOR HIP ARTHRITIS – A SHORT TERM OUTCOME ANALYSIS

DISSERTATION SUBMITTED FOR

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CERTIFICATE

This is to certify that this dissertation entitled ***"SHORT TERM ASSESSMENT OF RESURFACING HIP ARTHROPLASTY"*** *is the bonafide work done by* ***Dr. I. Geethan.*** *under my direct guidance and supervision in the Department of Orthopaedic surgery, Madras Medical College, Chennai – 3 during his period of study from Jun 2006 – Sep. 2008.*

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INDEX

Introduction

INTRODUCTION

Arthroplasty is an operation to restore pain free motion to a joint and function to the muscles, ligaments and other sort tissue structures that control the joint.

The goals of total joint arthroplasty are to relieve pain, to provide motion while maintaining stability and to correct deformity.

Pain in the hip joint is one of the most common causes in disabling human locomotion. Pain in the hip may be due to various causes and there are many ways of treating it. Analgesics, arthrodesis, osteotomy, excision arthroplasty, and replacement arthroplasty are some of them.

Total Hip Arthroplasty is the most commonly performed adult reconstructive hip procedure. Implanting artificial femoral head and acetabular socket to replace the degenerated/ destroyed hip joint will relieve the pain and provides pain free, mobile and stable joint.

The conventional Total Hip Arthroplasty with a cobalt-chrome head and polyethylene bearing surface has proved very effective in late middle aged and elderly patients. However in younger, high demand patients, this procedure can lead to early aseptic loosening, bone loss, and wear related osteolysis. This trend worsens by 16 years post operatively, with reported survival figures as low as 33%[1].

Surface arthroplasty of the hip is an appealing concept offering numerous distinct advantages over total hip arthroplasty, especially, in young individuals requiring hip arthroplasty. Following hip resurfacing, the proximal femoral bone stock is preserved[2-4], thereby providing a wider range of options for later revision, the stress transfer to the proximal femur is optimized[5] and the stability and range of motion are improved by the large area of articulation and the more precise biomechanical restoration of the hip[6,7]. In addition, the risk of arthroplasty induced limb length discrepancy is eliminated[3]. Considering the unsatisfactory long term survival rates of primary total hip arthroplasty in young individuals, surface arthroplasty is likely to occupy an important niche amongst the surgical options available in this subset of the population[8].

While metal on metal hip resurfacing provides certain theoretical advantages, at the bearing surface, the device and procedure also introduce the potential for complications including femoral neck fracture, exposure to metal ions, femoral component loosening from osteonecrosis or adverse femoral neck remodeling. Hip resurfacing is also a technically demanding procedure. Learning curve is steep and precise implantation and instrumentation is required for optimal results.

Hence the problems associated with surface arthroplasty can be divided into two main groups (1) those associated with any type of hip arthroplasty such a dislocation, thromboembolic disease, heterotopic ossification, nerve palsies, and vascular damage; and (2) those that are specifically related to surface arthroplasty such as femoral neck fractures, avascular necrosis of the remnant head, raised metal ion levels, and migration of the acetabular component.

Major modes of failure with the present generation of surface arthroplasty are femoral neck fracture and loosening of the femoral component[9]. With the reduction of wear related failures brought about by advances in metallurgy and design, other mechanisms of failure are gaining importance. Osteonecrosis of the femoral head remnant has been implicated as a mechanism that can result in femoral neck fracture and implant loosening[9,10]. The use of posterior approach results in sacrifice of the deep branch of medial circumflex femoral artery, the chief source of blood supply to the majority of the femoral head. The retinacular vessels may be damaged during head preparation with the reamers, at their point of point of entry into the vascular foramina at the junction of the head and neck. The retinacular vessels can also be damaged because of lateral neck notching, excess valgus positioning of the femoral component or during removal of osteophytes around the neck. It has been postulated that most of the blood supply to the arthritic femoral head comes from intraosseous vessels rather than the subsynovial vessels at the surface of the femoral neck[11]. This change in the pattern of blood supply is believed to offer protection against osteonecrosis after hip resurfacing.

We are presenting the short term follow up of functional results of resurfacing hip arthroplasty prospectively done in our institute during last 3 years.

Aim

AIM

The aim of this study is to analyze the short term follow up of functional results of twelve resurfacing hip arthroplasties prospectively, done using ICON articular surface replacement prosthesis done in our Institute during the period June 2006 to August 2008.

Literature Review

HISTORICAL REVIEW

THE EVOLUTION OF RESURFACING HIP ARTHROPLASTY

Conventional Hip Arthroplasty in Young Individuals:

Malchau (2002) et al analyzed the Swedish total hip replacement register and recorded the following observations with regard to uncemented total hip replacements[12]. The cohort operated on from 1979 to 1989 had an implant survival rate of 56.9%. The total number in this cohort was 1772. For the cohort operated from 1990 to 2000, the ten-year survival rate was 87.7% based on 2744 observations. Overall, the revision rate was significantly higher in patients less than 55 years of age. These findings emphasize the limitations of total hip arthroplasty in young patients and the relevance of a bone conserving alternative in this subset of patients who are likely to outlive a primary hip arthroplasty.

Early experiments

Contemporary designs have evolved directly from the original mold arthroplasty introduced by Smith Petersen in 1948[13]. It was a hemiathroplasty with no means of stable fixation. The first total resurfacing was developed by Charnley in the early 1950's using a Teflon on Teflon Bearing. This implant was associated with early failure that Charnley attributed to avascular necrosis of the femoral head [14,15]. In 1960 Townley attempted hip resurfacing using a metal-on-polyurethane articulation[16]. It was also associated with catastrophic wear. In 1967, Muller designed a metal-on-metal articulation[17]. Despite excellent clinical results, he abandoned it in favour of metal-on-poly articulation. Six of these all-metal articulations were revised after functioning up to 25 years.

Gerard introduced a bipolar metal-on-metal resurfacing in 1970[18]. The system consisted of a Luck cup inserted into an Aufranc vitallium cup with movement occurring between the outer cup and bony socket. In 1972, the Aufranc was substituted with a polyethylene cup in an attempt to decrease friction between the two implants. However, the convex surface of polyethylene component that articulated with the acetabulum wore rapidly and this combination was abandoned in 1975 in favor of a metal bipolar combination with a polyethylene inlay.

In Japan, Furuya performed 13 hip resurfacings using a stainless steel acetabular component with a high density polyethylene (HDP) femoral component fixed with cement[19], and then subsequently reversed the material combination, using a metal or ceramic femoral component. In 1972, Nishio combined an Urist acetabular component with his own femoral component made from vitallium[20]; in 1975, they substituted the acetabular component with a polyethylene-lined cementless socket. Tanaka, in 1974, introduced a hybrid system with a cemented eccentric socket and a metal head[21].

The first generation

Cemented hip resurfacings using polyethylene acetabular component and metal femoral components were implanted in 1971 by Paltrinieri and Tretani in Italy[22] and in 1974 by Freeman in the U.K. Freeman[23,24] had earlier used a HDP femoral component and a metal acetabular component, but this was associated with a rapid wear of the convex surface. In the same year in Germany, Wagner introduced a hip resurfacing that became widely used in Europe[25]. The acetabular components had a thickness of only 4 mm. Cobalt Chromium (Co-Cr) and ceramic femoral components were available, but head preparation was crude. Starting in 1976, a cementless alumina ceramic on ceramic resurfacing was used by Salzer in Vienna[26] but was soon abandoned because of high rates of early loosening.

In 1973 in the US, Fischer and Capello developed a cemented hip resurfacing using a metal femoral head and a polyethylene acetabular component[27]. The acetabular component was reinforced with a metal backing in 1982. In 1975, Amstutz introduced the THARIES (total hip articular replacement using internal eccentric shells) at the University of Los Angeles[28.29]. The prosthesis was cemented and consisted of a Cr-Co femoral component and an all polyethylene acetabular component. Both components were eccentric with a maximum polyethylene thickness of 3.5 mm to 5.5 mm. A plasma sprayed metal backed polyethylene acetabular component for use with cement was introduced in 1982[29]. In 1983, Amstutz implanted the first cementless resurfacing arthroplasty with a Ti-6Al-4V femoral component, modular ultra high weight polyethylene acetabular liner, and pure titanium mesh porous backing[30, 31]. Initially the sockets were hemispherical with screws, and later, the first chamfered cylinder socket with interference fit was developed. In 1988, Amstutz developed porous coated cementless system with a Co-Cr femoral component, a modular liner and a Ti-6Al-4V acetabular component. In 1989, Buechel and Pappas[32] introduced a cementless resurfacing with a modular acetabular component and a titanium nitride ceramic coated titanium alloy femoral component.

Current Generation Metal-On-Metal Hybrid Surface Arthroplasty:

The renaissance of metal-on-metal articulations for total hip arthroplasty began in 1988. Weber introduced the metasul bearing, a precisely engineered, high carbon containing, wrought Co-Cr alloy with excellent wear characteristics[33]. Heinz Wagner introduced a second-generation hip resurfacing in 1991[34]. However it was difficult to implant and instrumentation was crude. In the same year McMinn introduced a hip resurfacing system based on cast Co-Cr alloy[35]. The initial design was smooth surfaced and press fit on both the sides. The following year the components were coated with hydroxyapatite. He later introduced a system in which both components were cemented. The difficulties with these initial systems lead to the development of hybrid system a cementless HA coated acetabulum.

The contemporary hip resurfacing systems have retained these features, a bearing made from high carbon-containing Co-Cr alloy, cementless fixation of the acetabular components, and cemented fixation of the femoral component.

Amstutz et al (2004) described the clinical and radiographic results of the first 400 hips treated with metal-on-metal hybrid surface arthroplasties[36]. The rate of survival of the components at four years was 94.4%. Twelve hips (3%) had a revision to a total hip replacement. Seven of the twelve hips were revised because of loosening of the femoral component, and three were revised because of a femoral neck fracture.

Daniel et al (2004) published the results of 440 consecutive resurfacing procedures done by them and followed up for a mean of 3.3 years and reported the requirement of revision surgery in only one of their patients[37]. Treacy et al (2005) reported a survival rate of 98% in 140 resurfaced hips at a mean follow up of 5 years[38].

Back et al (2005) reported a 99.14% survival in 230 resurfaced hips at a mean follow up of 3 years[39].

Advantages of Surface Arthroplasty over Total Hip Arthroplasty

Capello (1982) studied the results of revision of 24 resurfacing hip prostheses followed up for a minimum of one year[40]. There were no intra-operative complications. In comparison to revision of conventional hip arthroplasty, he found revision of failed resurfacing hip arthroplasty to be technically easier. He demonstrated a lower complication rate with revision of failed resurfacing arthroplasty than with revision of failed conventional hip arthroplasty.

Amstutz et al (1984) compared the results of 100 hips resurfaced using the THARIES system with the results of conventional total hip arthroplasty followed for two to seven years and observed that the results were remarkably similar after matching for age, postoperative activity level, and length of follow-up[2]. They stated that, after surface arthroplasty, stability was excellent and the proximal femoral bone stock was preserved.

Gore et al (1985) compared the hip function after total hip replacement and surface arthroplasty[6]. Kinesiologic measurements were made in two groups of 20 men before and 6 and 24 months after resurfacing or conventional replacement. Pre-operatively the group that underwent hip had less pain, slightly more hip motion, greater muscle strength, walked faster, and used fewer assistive devices during walking than the group that underwent the conventional replacement. After surgery, the group with resurfacing was found to maintain its advantage in muscle strength and walking velocity.

McMinn et al (1996) observed the absence of dislocation after hip resurfacing in a series of 235 resurfaced hips followed up for 5 years[35].

Kishida et al (2004) compared Birmingham hip resurfacing (BHR) arthroplasty with cementless total hip arthroplasty, in terms of the effect on bone mineral density (BMD) of the femur[5]. The periprosthetic BMD of the femur was measured using dual-energy x-ray absorptiomentry, two years after the surgery. The post-operative loss of the BMD in the proximal femur was significantly greater in the cementless total hip arthroplasty group as compared to the BHR group. They concluded that hip resurfacing preserves the bone stock of the proximal femur after surgery

Girard et al (2006) compared the biomechanical nature of the reconstruction of the hip in conventional total hip arthroplasty and surface replacement arthroplasty in a randomized study involving 120 patients undergoing unilateral primary hip replacement[7]. On the basis of their observations on the femoral offset and limb length inequality in the two groups, they concluded that restoration of the proximal femoral anatomy was more precise with surface arthroplasty. They also stated that the enhanced stability afforded by the use of a large-diameter femoral head avoided over-lengthening of the limb.

Ball et al (2007) compared the results of revision of 21 surface arthroplasties with sixty-four primary total hip arthroplasties[41]. There was no significant difference between the conversion arthroplasty group and the conventional arthroplasty group with regard to operative time, blood loss, or complication rates. At a mean follow-up of forty-six months for the conversion arthroplasty group and fifty-seven months for the primary conventional total hip arthroplasty group, there was no significant difference in the clinical outcome, assessed using the Harris Hip Score, the UCLA pain, walking, and activity scores and the Short Form-12 score.

ANATOMY

The hip joint is a classical ball and socket joint created by the articulation of the head of the femur with the concave socket of the acetabulum.

The acetabulum is created by the confluence of the ilium , the ischium, and the pubis. The articular surface of the acetabulum presents a horseshoe like surface with a central, inferiorly directed notch that contains the pulvinar, a fat cushion covered with synovium. The cartilage of both the femur and the acetabular surface is thicker peripherally and thinner centrally. The opposing surfaces are regularly and reciprocally curved, but at any given time only two fifths of the femoral head occupies the acetabulum. The acetabulum is directed approximately 45° laterally and 15° anteriorly.

The proximal most portion of femur has a medial branch out the femoral neck and spherical summit the head. The neck and head are in 10° to 15° of anteversion.

The hip joint is diarthrodial synovial joint with synovial membrane lining the anterior neck of the femur to the intertrochanteric line but only the medial half of the posterior neck. The joint is covered by a capsule made up of outer longitudinal and inner circular fibers, anteriorly the thick iliofemoral ligament, posteriorly the thinner ischiofemoral ligament, and inferiorly the pubofemoral condensation. The acetabular labrum is a firm fibrocartilage attached to the rim of the bony acetabulum which deepens the acetabular socket. The ligamentum teres attaches the head to the actabulum

Characteristic vascular patterns feed the hip. rich subsynovial anastomoses occur at the margins of the articular cartilage. Pericapsular vessels are seen at the attachment of the capsule at athe acetabulum and enclose anastamoses from the femoral circumflex artery, acetabular branches of the obturator artery, and articular branches of the superior gluteal artery. Freeman has demonstrated that the vascularity of an arthritic hip is different with major supply from the intraosseous vessels. This might explain why avascular necrosis of femoral head is not a significant problem after surface replacement.

Anatomic considerations for the choice of Surgical Approach for Hip Resurfacing Arthroplasty have been investigated[42]. The optimal operative approach for hip resurfacing arthroplasty is controversial, and each proposed technique has advantages and disadvantages. In contrast to the initial experience with metal-on-polyethylene hip resurfacing arthroplasties, the majority of which were done through approaches that dislocated the hip anteriorly, most current-generation metal-on-metal hip resurfacing procedures for which results have been reported were performed through the posterior approach. The advantages of the posterior approach include the excellent exposure after circumferential capsulotomy, the preservation of the hip abductor muscles, and its ease of reproducibility by the majority of surgeons. However, with the release of the short external rotator muscles, the main blood supply to the retinacular vessels of the femoral head (the ascending branch of the medial circumflex artery) is sacrificed. This may lead to a compromised blood supply and osteonecrosis. The anterolateral approach appears to produce less disruption to the blood flow in the femoral head-neck junction than the posterior approach for patients undergoing hip resurfacing. This may be reflected subsequently in a lower incidence of fracture of the femoral neck and avascular necrosis.

The role of devascularization in femoral failure has been questioned. It has been suggested that the presence of osteoarthritis favors the development of an intraosseous blood supply within the femoral head, hence reducing the role of the extraosseous vessels. Blood flow and oxygen tension studies of osteoarthritic femoral heads, however, have not confirmed this. Some surgeons who perform hip resurfacing arthroplasty advocate a vascular-sparing approach, although compromising the extraosseous blood supply does not appear to be a major clinical issue with current designs of hip resurfacing prostheses implanted through the posterior approach.

With respect to soft tissue preservation during lateral and posterolateral approaches the recommendations made are that, the gluteus maximus should he released from its anterior insertion at the iliotibial band rather than split, for the Hardinge approach, the proximal extension of the gluteus meduis muscle split must be limited to 4 to 5 cm from tip of the trochanter, posterior approaches are to be avoided considering the difficulty in achieving adequate exposure while preserving head vascularity, and that trochanteric slide osteotomy is ideally suited for to provide optimal expore for this procedure.

Muscles producing the movement

Flexion

Psoas major and iliacus assisted pectineus, rectus femoris and Sartorius

Extension

Gluteus maximus and hamstring muscles

Adduction

Adductors longus, brevis and magnus assisted by pectineus and gracilis

Abduction

Glutei medius and minimus assisted by tensor fascia lata and Sartorius

Medial Rotation

Tensor fascia lata and anterior fibers of gluteus medius and minimus

Lateral rotation

Obturator muscles, gamelli and quadratus femoris assisted by piriformis, gluteus maximus and Sartorius.

BIOMECHANICS

Bone is a living structure and its shape and structural properties change according to how it is loaded. The implant materials react biologically with the body in a way that can cause considerable damage if care in their selection is not taken.

The forces acting on hip joint are that due to external load, i.e., body weight and that due to muscle forces. Knowledge of these forces is essential to design prostheses that will withstand the same. The experimental way of measuring these stresses has been replaced by computational methods, the Finite Element Analysis.

Humans having bipedal gait bear the entire body weight on the hips. This is about one third of body weight in each hip. The plane of force coincides with the strongly developed trabeculae that lie in the medial portion of the femoral neck and extend upwards through the superomedial aspect of the head of femur. These trabeculae are in line with the acetabular trabeculae that extend medially towards the sacroiliac joint.

In surface replacement arthroplasty of the hip the natural transmission of weight bearing forces is emulated. This has a beneficial effect on the bone on either side of the joint. It encourages mineralization and improves the bony quality of proximal femur and acetabulum. This in turn makes subsequent revision procedures easy and predictable should they be required.

The center of gravity of human body lies just anterior to the second sacral vertebra. This is posterior to the axis of the joints. Thus there is a posterior bending force in the sagittal plane.

The iliofemoral ligament of Bigelow neutralizes this. The posterior deflecting forces are particularly active when trying to sit down or get up, using stairs or walking on an incline.

In single leg stance, the center of gravity moves away and distal to the loaded hip. This tends to turn the body mass to the non weight bearing side in the coronal plane. This force is counter balanced by the combined action of abductors and other hip stabilizers. Since the ratio of the length of the lever arm of the body weight from center of femoral head to the abductor lever arm is 2.5: 1., the abductor force is two and a half times as body weight and consequently the joint reaction force which is the sum of the two is about three times the body weight. In resurfacing hip arthroplasty these forces are not altered.

Peak contact forces across the hip joint while doing various activities have been calculated to be 5-6 times body weight. In surface replacement since the acetabular shell is uncemented a waiting period of three months is prudent before normal activities are resumed[43].

IMPLANT DESIGN

Metal-on-Metal Bearings

Prosthetic bearing surfaces for hip resurfacing operations are currently manufactured from high-carbon (0.20% to 0.25%) cobalt-chromium-molybdenum alloy. The implants are either cast or forged, and casting may be followed by heat treatments that do not change the chemical compositions but do alter the microstructure (for example, porosity)[44]. The relationship of these different microstructures to long-term wear resistance is controversial, although recent hip-simulator studies examining the effect of heat treatments have not demonstrated an important difference[45].

Lubrication theory predicts that, in contrast to the extensive wear resulting from large-diameter polyethylene resurfacing components, the large-diameter metal-on-metal components could potentially result in very low wear if other important factors such as surface smoothness and, in particular, diametral clearance (the difference between the diameters of the femoral head and acetabular cup) are optimized[46].

While the optimal clearance to achieve elastohydrodynamic lubrication and avoid equatorial seizing is still being studied and debated, tribologists recommend that the diametral clearance be as small as possible in large-diameter bearings[46]. This requirement must be balanced against practical limitations of manufacturing tolerances and also must take into account the possibility that deformation of the acetabular component may occur when it is implanted into the acetabulum with a press-fit of 1 to 2 mm. Further deformation of the acetabular component, and subsequent reduction of the effective clearance, may also occur with physiological loading. The effect of deformation of the acetabular component on clearance has been studied experimentally in cadaver pelves or foam models and with the use of finite-element modeling. Both studies showed that the most important factor influencing deformation of the acetabular component was the wall thickness of the component, although diametral clearance and component diameter also were important. Deformation was greater in acetabular components manufactured with thin (2 to 4-mm) walls to conserve pelvic bone.

Wear of Retrieved Components

Metal-on-metal articulations produce small but measurable quantities of mostly nanometer to submicrometer-sized metal particles that can migrate systemically. The high number of these very small particles presents a large cumulative surface area for corrosion. Additional metal debris can be produced by component malposition, impingement, third-body wear, or component loosening. In terms of actual in vivo wear, early data from analyses of retrieved McKee-Farrar prostheses showed an average linear wear rate of 0.003 mm/yr and 0.004 mm/yr for the femoral head and the acetabular cup, respectively[47]. Interestingly, the larger-diameter femoral heads (42 mm) had a twofold lower mean volumetric wear rate compared with the smaller-diameter heads (35 mm): 0.7 compared with 1.4 mm/yr[47]. Wear rates tended to increase as clearance increased over the range of 127 to 386 μm, but there was no apparent relationship between clearance and the time to revision surgery.

Wear-depth measurements of retrieved modern hip-resurfacing components have generally been in agreement with hip-simulator predictions of low wear of well-manufactured, well-positioned implants. Wear rates of >100 μm/yr were associated with malpositioned sockets.

Those failures commonly were associated with tissue metallosis and a focal concentrated wear zone on the femoral component as the result of edge loading; wear-induced osteolysis has been noted in such cases. There was a wide range of diametral clearances (123 to 400 µm), with metallosis occurring with very high clearance.

Reaction to Debris

Locally, particulate metal has been shown to cause the release of inflammatory cytokines from macrophages and wear-induced osteolysis is occasionally reported, usually as a consequence of metallosis from malfunctioning implants[48]. The migration of particulate metal and corrosion products to distant end organs has been reported in association with metal-on-polyethylene hip and knee components retrieved at autopsy, and these products can induce pathological changes such as histiocytosis, fibrosis, or necrosis. The possibility of long-term consequences of chronic particulate metal release, including carcinogenicity or other metabolic disorders, is often noted as a concern. However, a meta-analysis showed no increased risk to patients with metal-on-metal conventional total hip replacement implants[49]. Nevertheless, MacDonald cautioned that studies to detect a rise in such adverse effects would require many thousands of patients to be followed for several decades[50]. Such data are not available from studies on hip resurfacing procedures.

Osteolysis as a result of metal allergy rather than wear debris has been reported in association with metal-on-metal hip replacements in a small number of cases. Although the prevalence of wear-debris-induced osteolysis and allergic reactions in patients who have had a metal-on-metal hip resurfacing arthroplasty appears to be <1%, the longest current clinical experience has been limited to two or three implant designs and more clinical data are required to determine the true prevalence of these complications.

In conclusion, the metallurgical properties of the implant and the bearing geometry is important in determining the wear performance of large diameter metal on metal bearing. The geometric variables identified are

- Radial clearance,
- Sphericity
- Effective roughness of the surfaces
- Bearing diameter

The most highlighted of these is the radial clearance

Clearance is the main parameter that influences the wear of the metal on metal bearing.a small clearance leads to fuid film lubrication, which decreases the wear of the bearings, but making it too small would lead to equatorial contact and jamming of the components. This becomes more pronounced after seating the implants as there is further deflection of the cup at the equator. The minimum bearing clearance identified, which does not lead to seizure of the articulation as determined for a particular size and design of the implant is ideal.

The carbide content of the alloy and its morphology are metallurgical variables that have been identified to play a significant role in wear characteristics. A higher carbon content in the 0.20- 0.25 percent leads to harder alloys with lower wear.

The steady state wear rate of metal on metal articulation is significantly lower than that with metal on poly bearings.

The preferred mode on fixation is hybrid with acetabular side being uncemented and the femoral side fixed using low viscocity cement. Use of stemmed femoral prosthesis is recommended particularly where smaller size implant implant is chosen.

INDICATIONS FOR RESURFACING HIP ARTHROPLASTY

The ideal candidate for a metal-on-metal hip resurfacing operation is young and active and has isolated hip disease with good proximal femoral bone quality and morphology and normal kidney function. The patient should relatively normal proximal femoral anatomy. The patient presents with severe pain and disability secondary to structural damage to articular surface of the hip without having damaged much of the underlying bone on either side of the joint. This type of physiology will allow the patient to resume an active lifestyle once pain relief is achieved by an arthroplasty procedure[51].

The common indications being

- Osteoarthritis
- Rheumatoid arthritis
- Early ankylosing spondylitis
- Post traumatic arthritis
- Osteonecrosis
- Limited indications in degenerative conditions secondary to
  - Developmental hip dysplasia
  - Slipped capital femoral epiphysis
  - Legg-Calve-Perthes' disease
  - Collagen disease

- Other inflammatory arthritis

The contraindications are

Absolute

- Contraindications as in conventional hip surgery (active/recent sepsis, osteoporosis, insufficient bone stock, poor hip musculature, neuromuscular disease involving the hip)
- Elderly people with osteoporotic bone
- Known metal hypersensitivity
- Impaired renal function
- Immature skeleton

Relative

- Inflammatory arthritis (especially if bone qualities is poor)
- Acetabular dysplasia
- Grossly abnormal proximal femur as in severe Perthes' disease and severe SCFE
- Large avascular necrosis of femoral head
- Contralateral replaced conventional total hip in relatively older patient

High risk factors

A combination of two or more of the following factors make surface replacement an unsuitable option

- Femoral head cyst > 1cm

- Decreases bone mineral density
- Lateral head neck remodeling
- Poor bone shape/ Biomechanics
- Short femoral neck (< 2 cm)
- Head neck ratio < 1.2:1
- Shallow or small acetabulum

SARI (Surface Arthroplasty Risk Index)[52]

The patients were assigned a numerical value on the basis of the presence of four risk factors:

- femoral head cysts of >1 cm (2 points),
- a weight of <82 kg (2 points),
- previous proximal femoral surgery (1 point),
- University of California at Los Angeles (UCLA) activity score of >6 (1 point).

SARI score of >3 represented a twelvefold increase in the risk of early failure or adverse radiographic change.

Arthritic Hip Grading system

Anteroposterior radiograph of the hip in 15 degrees of internal rotation is used to asses.

Four characteristics where assessed.

- Bone density
- Shape
- Biomechanics
- Local Bone Defects

Metal hypersensitivity is an issue. Patients with impaired renal function are not proper candidates. The use in young women desirous of getting a child is better avoided.

Hence an ideal candidate for a hip replacement surgery would be

- Young
- Active person
- Symmetrical geometry of the bone
- Good local bone quality with no cysts.
- No renal impairment.

COMPLICATIONS AND CRITICISMS OF RESURFACING HIP ARTHROPLASTY

Fracture of the femoral neck is unique complication of hip resurfacing. Capello (1978) recorded a 12% incidence of femoral neck fracture in a series of sixty six metal-on-polyethylene surface arthroplasties[53]. Amstutz, in his series of 400 metal-on-metal hybrid surface arthroplasties, observed 3 cases that failed due to femoral neck fracture[36]. In series of 440 hip resurfacings, followed for a mean of 3.3 years, Daniel noted no cases of femoral neck fracture[37]. Shimmin analyzed the records of the Australian national joint replacement registry which revealed a fracture rate of 1.46% at a mean of 15.4 weeks postoperatively[54].

Fixation of the femoral component is probably the most important factor determining the long-term survivorship of the current generation of metal-on-metal bearings. Capello (1984) reported a series of 116 resurfacings in which revision of surface arthroplasty was done for loosening of acetabular component in 3 hips, for loosening of femoral component in 3 hips and for loosening of both components in 7 hips[55]. Campbell et al (2006) observed 23 cases with loosening of the femoral component in a series of 98 failed resurfacings subjected to implant retrieval analysis[9]. Shimmim et al have identified metal ion hypersensitivity and femoral impingement as additional important complications of hip resurfacing[56].

Prevalence of Osteonecrosis in Failed Hip Resurfacings:

Bradley et al (1987) assessed the viability of the femoral head remnant by histologic examination of bone inside 25 failed femoral resurfacing components[57]. The bone was substantially alive throughout the femoral head in 23 of 25 cases (92%). In two cases, the bone of the femoral head was dead. Both of these hips had clinically failed because of femoral neck fracture.

Histologic examination of 72 femoral heads retrieved at revision of resurfacing arthroplasties was performed by Howie et al (1993), to determine the possible role of generalized osteonecrosis in early loosening of the femoral component[58]. The degree of loosening at the femoral bone-cement interface was correlated with the histologic appearance of the femoral heads. None of the ten femoral heads with solid femoral components and only one of the 15 heads with slight loosening showed evidence of generalized osteonecrosis. The one case was attributed to avascular necrosis (AVN) after the resurfacing procedure. In the remaining femoral heads with marked loosening of the femoral component, necrosis of bone was uncommon.

Campbell et al (2000) histologically analyzed 25 resurfaced femoral heads followed up to 12 years postoperatively and inferred that osteonecrosis was not induced by the procedure[59].

Little et al (2005) presented the histological findings of bone retrieved from beneath the femoral components of failed metal-on-metal hip resurfacing[60]. Thirteen out of a total of 377 patients who underwent resurfacing arthroplasty required revision surgery. Revision was done for fracture of the femoral neck in eight, loosening of a component in three and for other reasons in two. None of these cases had shown histological evidence of osteonecrosis in the femoral bone at the time of the initial implantation. Bone from the femoral head remnant showed changes of osteonecrosis, in all but one case, at revision. In two cases of fracture which occurred within a week of implantation, the changes were compatible with early necrosis of the edge of the fracture. In the remaining six fractures, there were changes of established osteonecrosis. In all but one of the non-fracture cases, patchy osteonecrosis was seen. They found histological evidence of osteonecrosis to be a common finding in failed resurfaced hips. The authors concluded that osteonecrosis is extensive in resurfaced femoral heads which fail by fracture, and that it is likely to play a role in the causation of these fractures.

Campbell et al performed implant retrieval analysis on 98 failed surface arthroplasty components from different manufacturers[12]. Analysis involved sectioning the components, measuring cement mantle thickness and the depth of penetration, histopathology, and measurement of the bearing wear. A finite element model was constructed to examine cement thermal necrosis. Femoral neck fracture (28) and femoral loosening (23) were the main causes of failure. Fractures were the main cause of short-term failure. Twenty-three occurred less than 6 months after surgery (median, 2 months). Longer term femoral neck fractures occurred in five cases (median time to failure, 12.4 months) and was caused by extensive osteonecrosis of the femoral head, shown by the complete lack of viability of the bone and marrow. There was no repair to the original cut surfaces, suggesting the ischemia occurred at the time of surgery. Five of the failures caused by femoral loosening were associated with complete loss of fixation and femoral head shape because the proximal bone had been replaced by thick fibrous tissue that was often partly necrotic.

Criticisms

Considering the poor clinical history of metal-on-polyethylene resurfacing arthroplasties and the concerns over the unknown risks of long-term exposure to metal-on-metal bearings, some surgeons are skeptical about the widespread reintroduction of metal-on-metal hip resurfacing arthroplasty[61]. These concerns are in light of the success of many modern conventional total hip implants and the learning curve involved for surgeons who perform only a few hip resurfacing arthroplasties each year. In some authors' opinion there are a very limited number of patients for whom metal-on metal hip resurfacing is truly indicated. They also express concern that consequently very limited hip resurfacings are being performed and considering the steep learning curve associated with this procedure, the community orthopaedic surgeon cannot be expected to master the technique to perform this procedure correctly. It also raises the issue of osteoporotic periprosthetic fractures many years after implantation, a problem not addressed in the literature but known to occur with conventional hip replacements[62]. The lack of long-term follow-up of the new generation of hip resurfacing prostheses leaves many questions unanswered, and surgeons need to be aware that the proponents of hip resurfacing arthroplasty emphasize that it is a technically more demanding operation Finally concerns about increased levels of metal ions have not yet been fully addressed.

Materials & Methods

MATERIALS AND METHODS

This is a prospective study conducted at Department of Orthopaedics, Government General Hospital from June 07 to October 08. We had done 12 metal on metal resurfacing hip arthroplasty on 10 patients for various indications

Preoperative planning

The resurfacing hip arthroplasty is an elective surgery. A thorough preoperative evaluation is done. The indication for surgery, level of pain and disability, response to conservative therapy and the patient's expectations of results are reviewed. Informed consent was obtained from all the patients.

The general condition of the patient including his physical and mental status, general medical condition and ability to withstand the surgery are analyzed.

Physical examination includes besides the affected hip, the contralateral hip, spine and both knees. Any limb length discrepancy, fixed deformities and the available range of movements are noted. Abductor mechanism and stability of the hip are assessed. Any foci of infection is sought and treated prior to surgery.

Preoperative radiographic evaluation

The goal of preoperative radiographic evaluation is to confirm the diagnosis leading to surgical intervention, to determine the anatomic relationship of the femur and pelvis and to allow for accurate restoration of joint anatomy and biomechanics.

The most important roentgenographic view is of pelvis with both hips including proximal femora with hips in internal rotation.

Preoperative planning

The general goals are

- To determine the site and size of the implants
- To preserve the anatomic and biomechanic center of rotation of hip joint.
- To avoid limb length discrepancy
- To restore appropriate muscle relationship.
- To anticipate any problem likely to be met.

Preoperative planning includes the templating. It ensures the selection of implant with best fit.

Femoral sizing

The femoral component is sized to create an exact fit of its outer diameter with the inner diameter of the acetabular component.

The size selected is such that the femur when reamed does not notch at the neck. This is determined by templating preferentially at the neck. The distal diameter of the femoral implant (effective neck diameter)is kept slightly greater than the widest diameter of the neck(actual neck diameter). The smallest femoral size possible within these limitations is chosen

Femoral positioning

The femoral implant is positioned at a neural to 10° valgus compared to the natural neck shaft angle. It should never be in a varus angulation. Any defect in the region of the dome of the head is looked for. This is to determine the level of top reaming with the pin reamer. For a normal shaped head without any defect ream upto 6 mm mark.

Acetabular sizing

An acetabular component size is selected that matches the selected femoral component and fills the acetabular fossa. If the acetabular component does not fill well then the next set of matching size is chosen.

If excessive reaming is required to seat the acetabular component that matches the desired femoral component, then surface replacement is not a good option.

Acetabular positioning

The positioning of the template on the AP radiograph of the pelvis is in 45° of abduction of the acetabular component with complete lateral coverage and the medial aspect within two millimeters of the radiographic tear drop.

Pre operatively all patients were evaluated with Harris Hip Score, Oxford Hip Score and UCLA activity score.

Surgical Procedure

We used ICON Articular Surface Replacement Prosthesis in all patients. It is made of Cobalt Chromium Alloy.

Preparation of the patient

On the day of surgery, the skin is prepared using povidone iodine solution and covered with sterile clothes an brought to the theatre where the final preparation is done. Prophylactic antibiotics are given just prior to skin incision. We prefer a third generation cephalosporin 2 gm given iv.

Operation theatre

The surgery is ideally done in a theatre with laminar air flow, using body exhaust systems to reduce exogenous bacterial contamination. Adequate precautions are taken to maintain sterility like thorough fumigation, air conditioning, limiting the traffic in theatre.

Approach

Lateral position was used in all patients.

Exposure of the acetabulum without a prior femoral neck resection can present technical challenges. Accurate placement of a guide pin in the femoral neck is necessary to avoid varus positioning of the component and notching of the femoral neck.

We initially used a posterior approach with posterior dislocation to hip. In the later stages we used lateral approach and trochanteric flip osteotomy and anterior dislocation of hip, a modification of safe surgical dislocation described by Ganz et al. This provides adequate exposure of acetabulum and is believed to reduce intraoperative vascular insult.

Surgical Approaches used

Approach	No. of hips	Percentage
Posterior capsule sparing	10	83.33
Ganz safe dislocation	2	

Biomechanical Reconstruction

One goal of hip resurfacing arthroplasty is to closely reproduce the normal anatomy of the proximal part of the femur and the hip joint, and it has been suggested that implant positioning may have a greater impact on implant survivorship and patient function than it does in a conventional hip replacement. It is generally recommended that surgeons strive for a relative valgus placement of 5° to 10° while avoiding notching of the superolateral cortex of the femoral neck. The fact that some femoral necks naturally have a more varus orientation must be taken into account.

Although relative valgus orientation is favorable to implant survivorship, it results in a decreased femoral offset. This, combined with a limited capacity to correct a limb-length discrepancy of >2 cm, has put into question the capacity of hip resurfacing arthroplasty to properly restore hip biomechanics. However, both of these studies were retrospective, and, in a more recent prospective randomized clinical trial comparing hip resurfacing arthroplasty with conventional total hip replacement, Girard et al. found that a greater percentage of resurfaced hips had the offset reconstructed to within 4 mm of that on the normal, contralateral side.

The lack of modularity of the femoral component represents a major difference between hip resurfacing prostheses and conventional total hip replacement devices, especially when the surgeon attempts to optimize the femoral head-neck offset in order to minimize the risk of impingement and maximize the range of motion. The best method for optimizing the head-neck offset during hip resurfacing arthroplasty is still not known. One technique involves the removal of prominent osteophytes on the anterior aspect of the head and neck to restore femoral head sphericity, optimizing component sizing and facilitating accurate guidewire placement. Although osteophyte removal could weaken the femoral neck if it is done too aggressively, the arthritic femoral head is usually enlarged and thus the surgeon may tend to favor the use of a larger femoral component if the osteophytes are preserved. This will also result in the implantation of an acetabular component that is larger than what might have been used in a conventional total hip replacement.

Femoral sizing /gauging

Once the femoral head is dislocated posteriorly, it is freed of all the adhesions. The largest femoral neck diameter is assessed using the femoral gauge. The largest neck diameter is usually the superior inferior dimension. The size chosen is larger. The gauge should be kept not only across the widest diameter but also should run freely around the neck.

Acetabular preparation

The acetabulum is exposed by retracting the dislocated head anteriorly using a Hohman's retractor. Head is dislocated inferiorly when using Ganz approach. Pin retractors facilitate the exposure. The acetabulum is cleared of all the soft tissue and then reamed progressively. The reaming is stopped at 1 mm less than the desired cup size for a snug fit. Now the trial cup is seated. If the cup is loosely fitting, then it needs to be upsized along with the femoral implant. The appropriate size definitive cup is seated using an alignmnet rod. The aim is to have a 15° to 20° of anteversion and 45° of abduction. The implant is checked for stability.

Femoral pin insertion

Once the implant size has been decided the appropriate femoral gauge is used to mark the axes of the femoral neck on the superior and the posterior aspect. The lines are extrapolated to cross on the femoral head. The femoral head being deformed may have some degrees of eccentricity relative to the neck because of secondary remodeling. Thus the lines may not cross in the center of the top of the head. This intersection is used as a guide to place the guide pin in neutral to 5°-10° of valgus. The tripod, in neutral position both for angulation and translation, is then threaded on the guide pin. The stylus is run all around the neck to ascertain correct placement of the reference pin. In case any correction was required, the reference pin is readjusted in the correct alignment without removing the tripod.

The initial reference guide is inserted in 0°-10° of valgus and the pin is advanced deep into the head to gain secure purchase.

Femoral reaming

Femoral reaming is performed using a series of size specific cannulated reamers. These are pin reamer, Chamfer reamer and the 2 in 1 profile reamer and are used in the same order. The pin reamer is chosen based on the size decided. The reference arm stylus is reloaded this time on the pin reamer to ascertain the extent of final reaming and the clearance around the neck. The level of the tip of the stylus on the head/neck is the extent of seating of the femoral shell, any evidence of notching should be carefully excluded. The pin reamer is replaced by the reamer guide pin. The femoral head is then prepared with chamfer/ profile reamer of the same size.

Once the head is prepared, trial cup is seated and the distal limit of the implant marked on the bone. A trial reduction is done. Multiple drill holes are made on the top of the dome. A venting hole is made at the lesser trochanter. Low viscosity cement is poured on the cup and the cup placed on the prepared head and secured with a hammer on the pusher.

Once the cement is set, wound is washed and hip reduced. Capsule is repaired. The short external rotators and glutei are repaired. While using Ganz approach, the trochanteric flip osteotomy is reattached using two 6.5 mm cancellous screws and tensor fascia and fascia late repaired. Wound is closed over suction drain. Sterile dressing is done. Patient made supine with abduction pillow.

Post operative protocol.

The limb is kept abducted using a pillow in the post operative period. Ankle and toe movement is encouraged from day one. The patient is monitored for pulse rate, BP, respiration, urine output, soakage and drain output. Epidural analgesia is administered for 48 hours. Intravenous antibiotics are administered. We use third generation cephalosporin according to the sensitivity profile in our institution.

We do not routinely use thrombophylaxis. Blood transfusion is decided based on drain and post operative Hb value. Suction drain is removed after 24 – 48 hours.

Analgesics are continued as required. Injectable antibiotics are given for 7 days and then oral antibiotics for 5 days. In bed physiotherapy is started from first post operative day. This entails static exercises for the glutei and the quadriceps. The patient is made to sit up in the bed and also with legs hanging by the side of the bed. He/she is also taught ankle pumps and chest physiotherapy. Abduction pillow is continued. Analgesics are gradually weaned off.

The patient is allowed toe touch walking with crutch support as tolerated. This is continued for 6 weeks. The patient is discharged on day 12.

Patient continues supervised physiotherapy.

Follow up

The patient reports for follow up visits at 3 weeks and 6 weeks. At that time gradual weight bearing is permitted. Before 3 months patient is out of crutches and walks with cane support. At the end of 3 months, patient is permitted to resume activities of daily living including squatting, sitting cross legged and stair climbing. The patients were called back for review at 3 months interval. At the end of this study, they were evaluated with harris hip score, oxford hip score, and UCLA activity score. X rays were taken in anteroposterior and frog leg lateral and compared with the initial X rays for evidence for loosening, prosthesis migration, neck resorbtion and implant failure.

The duration of follow up at the end of this study ranged from 22 weeks to 60 weeks, with an average of 50 weeks

Results

OBSERVATIONS AND RESULTS

In our study we have analyzed the functional results of the metal on metal resurfacing hip arthroplasty, done in 12 hips of 10 patients in the Government General Hospital during the period June 2006 to May 2008.

In the study period, twelve hips were operated in ten patients. The age range was 17-40 years, average 26.3. There were 8 male patients and 2 female patients. Those females who were desirous of childbirth were excluded from the study and were offered other forms of treatment. The diagnosis leading to surgery was inflammatory arthritis in 5 patients (Juvenile ankylosing Spondylitis in 2 patients, Juvenile Rheumatoid Arthritis in 2 patients, Rheumatoid Arthritis in 1 patient) and secondary degenerative arthritis in 5 patients (secondary to AVN in 4 patients and post traumatic in 1 patient).

Sex ratio

Sex	No. of Patients	Percentage
Male	8	80
Female	2	20

Age Incidence

Age	No. of Patients	Percentage
15-20	2	20
21-30	6	60
31-40	2	20

The age range was 17-40 years, average 26.3

Side involved

Side	No. of Hips	Percentage
Right	7	58.33
Left	5	41.67

Indications for surgery

Indications	No. of Patients	Percentage
Inflammatory arthrtitis	5	50
Osteonecrosis	4	40
Post Traumatic arthritis	1	10

The study group was divided into inflammatory group (juvenile ankylosing spondylititis, rheumatoid arthritis and juvenile rheumatoid arthritis, 7 hips in 5 patients) and non inflammatory group (osteoarthritis following osteonecrosis and neglected trauma).

The average follow up was 50 weeks (range 22 to 60 weeks).

All patients were evaluated clinically and radiologically preoperatively and at various follow up periods. All the patients were analysed using Harris Hip Score and UCLA activity score. In our study 9 patients showed excellent results and one patient showed good result. The surgery could be categorized as successful in all patients by Modified Harris Hip Evaluation.

Clinical results

The Hip scores are summarized in the table (range in paranthesis)

Rating system	Score	
	PreOperative	Post Operative
UCLA		
Pain	1.8 (1-2)	9.0 (8-10)
Walking	5.6 (1-8)	9.8 (8-10)
Function	3.2 (1-6)	10
Activity	2.5 (2-3)	6.3 (5-7)
Harris Hip score	48.5 (16-78)	93.91(85-100)
Oxford Hip Score	50.2 (40-60)	13 (12-14)

The mean increase in the hip score was 44.3. In the inflammatory group the increase was 50.2 and in the non inflammatory group it was 38.4.

Only two patients scored activity score less than six. One patient had Juvenile Ankylosing Spondylitis and defaulted on medical management. The other patient had foot drop.

The range of motion was

	Pre Operative	Post Operative
Flexion	62.5 (0-90)	99.1 (80-110)
Abduction-Adduction arc	23.3 (0-60)	65.8 (50-75)
Rotation arc	20.8 (0-70)	60.0 (60-90)

The post operative flexion in the non inflammatory group was 108 degrees and in the non inflammatory group was 93 degrees.

There was preoperative shortening of 1 cm in one patient. It persisted post operatively.

One patient had screeching sensation on movement. Such a phenomenon was not reported by other patients.

There was no incidence of intraoperative or early post operative fracture neck of femur. No patient had dislocation.

Radiological results.

Heterotopic Ossification

One patient with Juvenile Ankylosing Spondylitis showed heterotopic ossification. His range of motion lesser than other patients.

Component positioning.

The acetabular component had been placed at an inclination of 43.3 (range 25-65). No loosening or alteration in the inclination noted in the study period. The femoral stem shaft angle was 140.5^0 (range 120^0-150^0). Notching was not noted in any case. There were no subsidence or varus drift.

Acetabular and metaphyseal stem radiolucencies

No patient had loosening or osteolysis noted around the acetabular cup or femoral stem. Cup protrusion or femoral component subsidence was not noted in any patients. Femoral neck scalloping or thinning was not noted in any patient.

Hip biomechanics

The hip ratio was calculated by dividing the abductor moment arm by the body moment arm. The hip ratio represents the relationship between the force exerted by the abductor muscles and body weight to maintain equilibrium in the one legged stance. The greater the ratio, the smaller the magnitude of the hip reaction force. Of the ten patients in the study, 3 had bilateral hip replacements (two bilateral HRA and one with contralateral THA). Two other patients were candidates for arthroplasty on the contralateral side. In the remaining five, the hip ratio was reduced in three and increased in two patients. The range was 92 to 106 percent compared to normal contralateral side. No clinical correlation was noted.

Implant survival

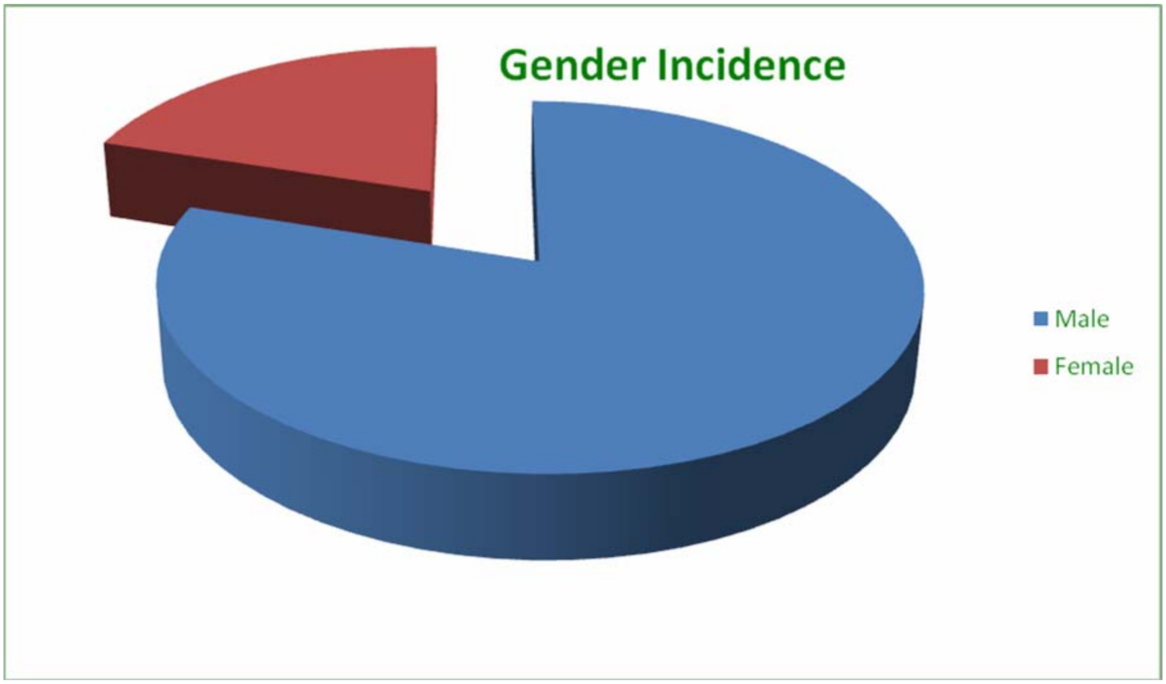
No implant needed to be revised during the period of study. There was no incidence of superficial or deep infection.

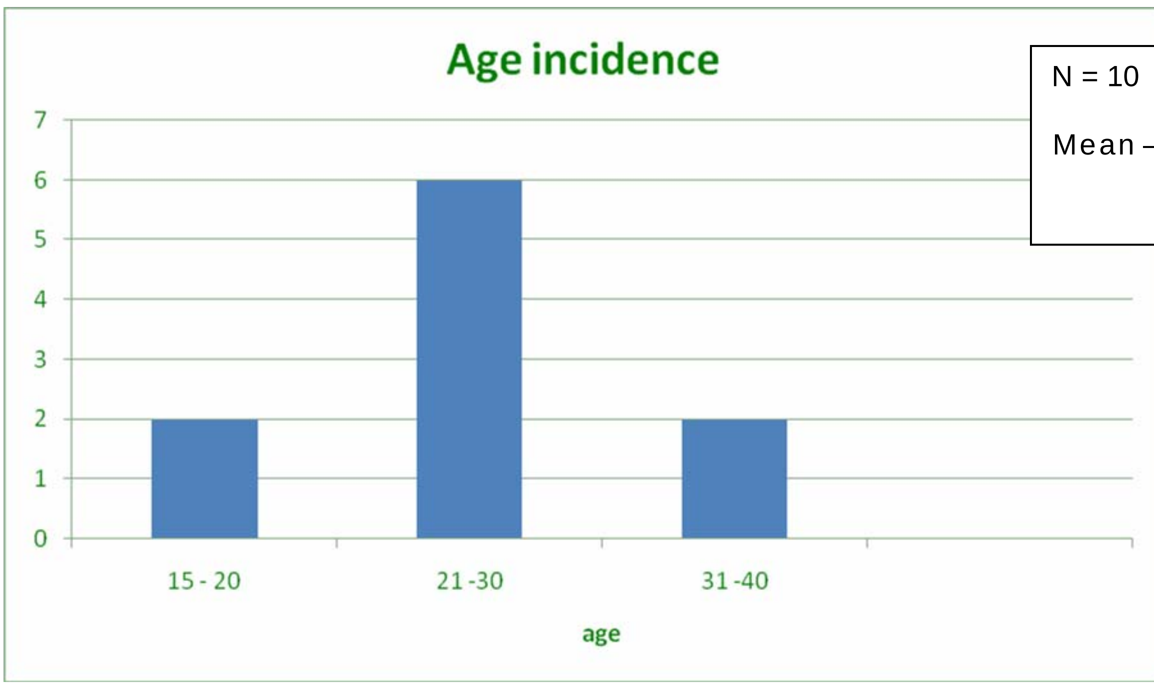
Other complication

Two patients developed foot drop post operatively. Both were treated with splinting and physiotherapy. Foot dorsiflexion recovered in one patient at 20 weeks. Other patient has not recovered. He has returned to employment with splint. There was no incidence of deep vein thrombosis.

Functional results.

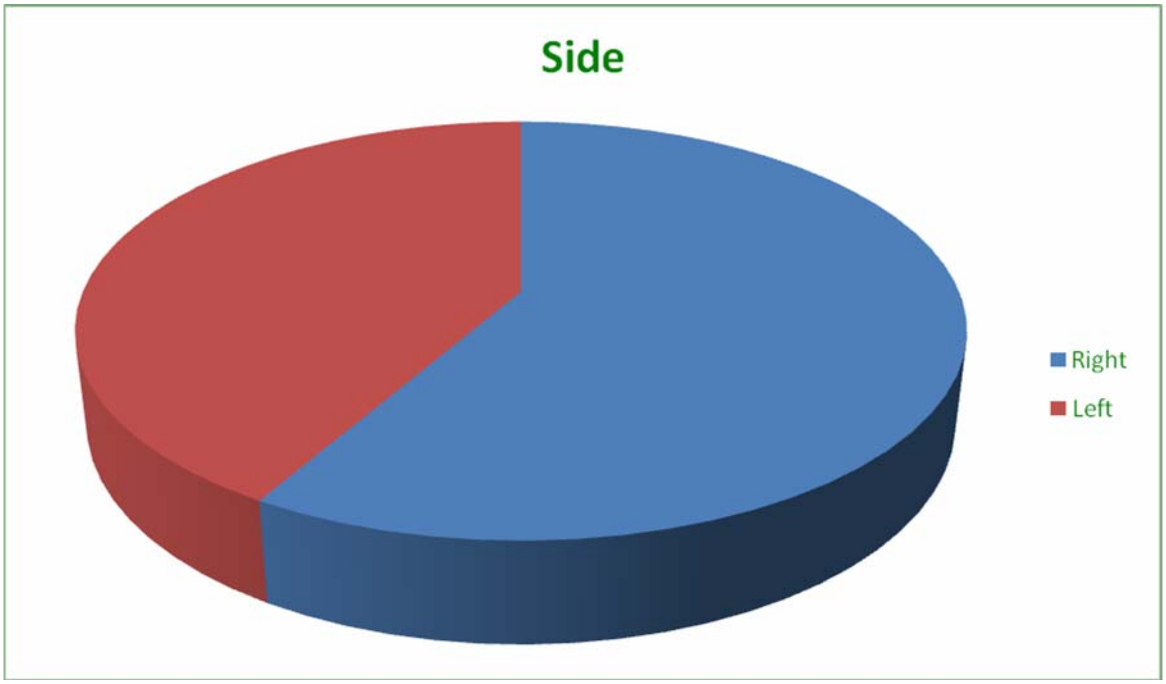
Of the ten patients, nine returned to premorbid function, eight being employed in their previous occupation and one patient has returned to school. One patient with Juvenile ankylosing Spondylitis is incapacitated by back pain.

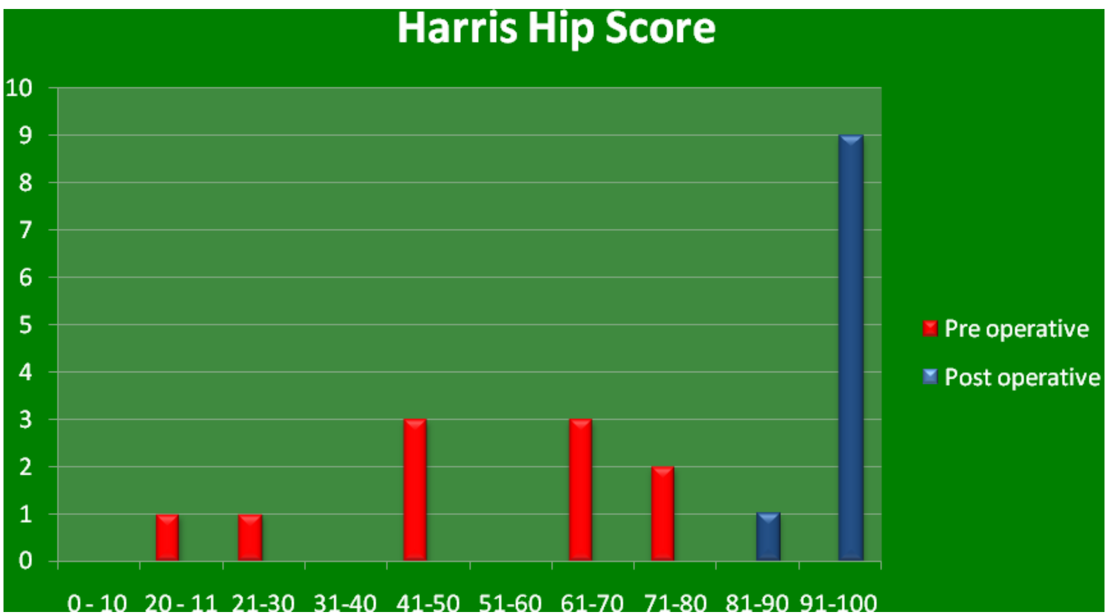

Gender Incidence
Male
Female

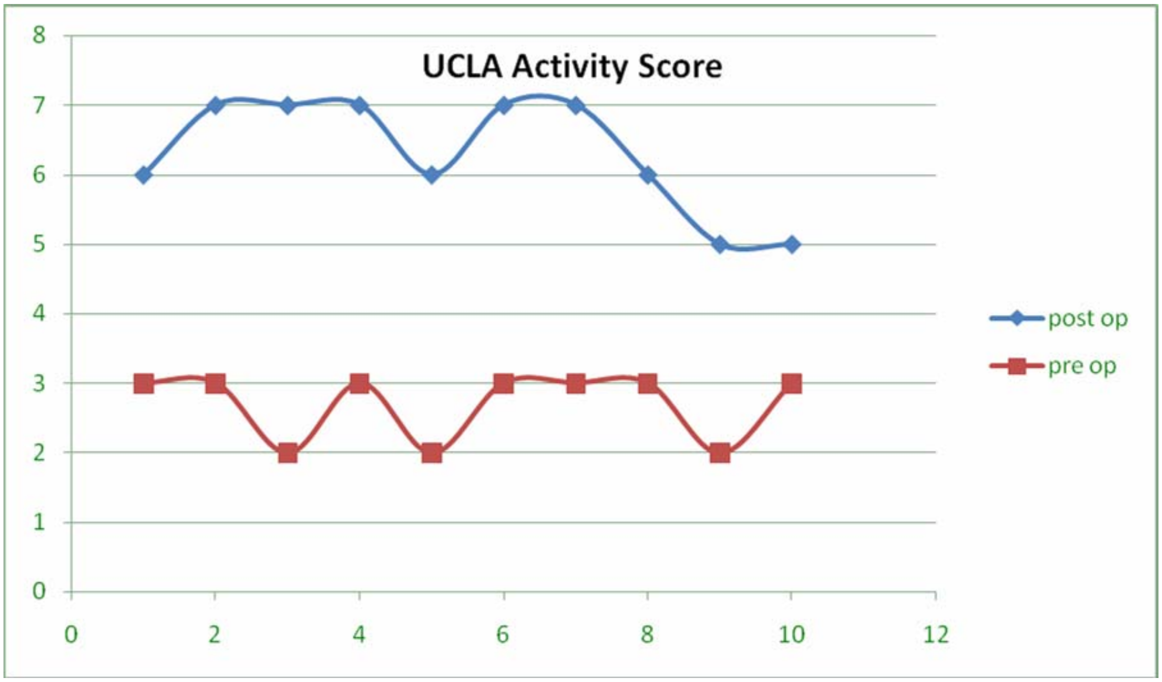

Age incidence
7
6
5
4
3
2
1
0
15 - 20
21 -30
31 -40
age

N = 10

Mean – 26.3


Side
Right
Left


Harris Hip Score
10
9
8
7
6
5
4
3
2
1
0
0 - 10
20 - 11
21-30
31-40
41-50
51-60
61-70
71-80
81-90
91-100
Pre operative
Post operative


UCLA Activity Score
8
7
6
5
4
3
2
1
0
0
2
4
6
8
10
12
post op
pre op

Illustrative cases

Case 1

This 16 years old male (case 3 in the master chart), presented with juvenile ankylosing spondylitis involving both hip joints. His pre operative hip score was 36 and activity score was 2. He underwent bilateral hip resurfacing arthroplasty on 02/07/07 and 04/09/07. He uneventful recovery and had hip score of 100 and activity score of 8 at 1 year follow up. The result was excellent.

Case 2

This 22 years male (case 2 in the master chart), presented with avascular necrosis of right hip joint. His pre operative hip score was 70 and activity score was 3. He underwent hip resurfacing arthroplasty on 14/08/07. He had uneventful recovery. His post operative hip score was 100 at 14 months follow up. His activity score is 8. The result is excellent.

Case 3

This 39 years female (case 6 in the master chart), presented with right hip arthritis following neglected hip trauma. Her preoperative hip score was 48 and activity score was 96. She had preoperative shortening of 2cm. She underwent resurfacing hip arthroplasty on 21/09/07. Post operative period was uneventful. Post operative shortening was 1 cm. acetabular and femoral components were in varus alignment. At 56 weeks follow up, she was asymptomatic albeit with a limp. Post operative hip score is 96. The result is excellent.

Case 4

This 40 years male (case 12 in the master chart), presented with bilateral avascular necrosis of hip. His preoperative hip score was 72 and activity score was 3. He underwent uncemented total hip arthroplasty for left hip and resurfacing hip arthroplasty for right hip. He has foot drop following surgery. Foot drop did not improve in the follow up period of 22 weeks. We is ambulant with a foot drop stop splint. His activity score is 5 and Harris Hip Score is 92. Result is excellent.

Case 5

This 23 years male (case 10 in the master chart) presented chronic arthritis of both hips due to juvenile ankylosing spondylitis. He had fibrous ankylosis in his right hip and only flexion in his left hip.He underwent bilateral hip resurfacing in two stages. Ganz approach for safe surgical dislocation was employed and the trochanteric flip osteotomy was fixed two 6.5mm cancellous screw. Post operative period was uneventful. At 30 weeks follow up, he had heterotopic ossification in left hip and loosening of one cancellous screw in right hip. His activity is limited by back pain and his activity score is 5. His Harris Hip score is 85 and the result is excellent.

Discussion

DISCUSSION

Hip resurfacing has had a renaissance in the last decade and is currently among the fastest growing hip procedures worldwide. It is an ideal option in younger individuals with appropriate proximal femoral geometry in whom symptoms are severe enough to warrant arthroplasty. The first generation involved cemented polyethylene acetabular and stemless femoral components. These resurfacing procedures were catastrophic failures due to polyethylene wear. The second generation of resurfacing involved the use of porous coated uncemented components with a chamfered cylinder for acetabular fixation and a stemless femoral component. This prostheses was never widely used. It was subsequently recognized that the reason for failure was the material and methods used and not the concept. This led to the development of newer generation of resurfacing implants. Currently metal on metal prosthesis made of cobalt chromium alloy, implanted without cement in acetabular side and cemented in the femoral side is the implant of choice. With the improved metals and techniques hip resurfacing has become a predictable procedure with potential for bone conservation and longer survival.

Because the reintroduction of the hip resurfacing concept is relatively recent, there is a lack of published long-term results. Most publications are from centers in which the authors have been involved with the design of the prostheses. The short-term (up to two-year) to medium-term (five-year) results of clinical outcome and survivorship studies from independent centers using contemporary hip resurfacing implants have been similar to, and complication rates have been comparable with, those of conventional total hip replacements.

With the exception of designs that involved a cemented acetabular component, current hip resurfacing prostheses (those involving cementless acetabular fixation—i.e., hybrid fixation) have been associated with encouraging early results.

We have assessed the clinical improvement after the procedure, by comparison of the pre-operative and post-operative Harris Hip Scores, Oxford Hip Score and UCLA hip score. The Harris Hip Score is the most commonly used scoring system for evaluation of the hip and has been found to provide a valid assessment of the status of the hip with excellent inter-observer and intra-observer reliability and reproducibility[63].

Clinical Profile:

The mean age of the patients was 26.3 years. All the patients belonged to the relatively young and active age group of less than 55 years, considered ideal for hip resurfacing. This group represents adults with high activity levels, and thereby likely to place a high demand on the implant. In view of the activity level and the long duration of life left in them, these patients are likely to require a revision arthroplasty at least once during their lifetime.

The study group included 10 hips in 8 males and 2 hips in 2 females. All the female patients were less than 50 years of age. The age of female patients is of particular importance, in view of the higher failure rates noted in older women in recent data[64]. Both the female patients were single and were not intending to have children for personal and social reasons.

Inflammatory arthritis including rheumatoid arthritis and ankylosing spondylitis was the most common indication, followed by osteoarthritis secondary to osteonecrosis of the femoral head. There were no patients with primary osteoarthritis of the hip. This in contrast to the clinical profile recorded in reports from Europe and North America, where primary osteoarthritis was the most common indication for hip resurfacing, and probably reflects the relative rarity of primary osteoarthritis of the hip in the Indian population.

Daniel, Pynsent, and McMinn (2004) from The Birmingham Nuffield Hospital and The Royal Orthopaedic Center reported a 99.8% survivorship at a mean of 3.3 years in a group of 446 hips in patients less than fifty-five years old with a diagnosis of osteoarthritis[37]. They also reported on 144 consecutive cases followed for a minimum of five years; the survivorship was 99% for aseptic cases[37].

At the Joint replacement Institute at Orthopaedic Hospital, Los Angels, California, Amstutz, Beaulé, Dorey, et al, (2004) reported a 94.4% survivorship at four years after 400 hip resurfacing prostheses performed with hybrid fixation in a group of patients (average age, forty-eight years) in which only 66% had a primary diagnosis of osteoarthritis[36]. They acknowledged that the limits of the hip resurfacing concept were probably being extended at their center. When their data were separated according to whether the patients had a surface arthroplasty risk index (SARI) of >3 or ≤3, the four-year survivorship rates were 89% and 97%, respectively. This suggests that patients with a higher risk index were 4.2 times more likely to require revision at four years.

More recently, Hing, Back, Bailey, et al (2007) reported a 99.13% cumulative survivorship at a mean of five years in a prospective study of 230 resurfaced hips[65] and Heilpern, Shah, Senior and Fordyce reported a survival at five years of 96.3 percent. At another center, Pollard, Baker, et al (2006) compared Metal on Metal hip Resurfacing and Total Hip Replacement[66]. The clinical and radiographic results of metal-on-metal hip resurfacing arthroplasty were compared with those of conventional total hip replacement in two groups of fifty-four patients matched for age, gender, body mass index, and activity level. At five to seven years, the total hip replacement group had a revision or intent-to-revise rate of 8% (four of fifty-one hips) due to polyethylene wear and osteolysis. The hip resurfacing group had a revision or intent-to-revise rate of 6% (four of sixty-three hips) due to femoral component migration. Both of these revised or intent-to-revise rates are higher than what one would expect from other published reports.

In our study we observed a survival rate of 100 percent at a short follow up.

There is debate about the range of motion achieved with hip resurfacing arthroplasty. In one report, by Back et al. (2005) the mean flexion range was 111.2°, which is lower than that reported after conventional total hip replacements[67]. In a prospective, randomized, controlled trial comparing seventy-six patients with a conventional hip replacement and eighty with a hip resurfacing arthroplasty, Lavigne et al.(2007) demonstrated no difference between groups in terms of the total arc of motion in all planes[68].

The mean ranges of movements observed in our study are flexion of 99 degrees (range 80-110 degrees), abduction- adduction arc of 66 degrees (range 50 -75) degrees, and rotation arc of 60 degrees (range 40 -90 degrees).

The question of how much of the remaining viable head and neck bone is required for successful hip resurfacing arthroplasty has not been answered in the literature. Patients with a diagnosis of osteonecrosis presenting with a SARI score of >3 are at a higher risk for early failure. The decision to proceed with hip resurfacing must be made after an assessment of the full risk profile of the particular patient. The question of whether to treat defects with cancellous bone graft or to fill them with cement has also not been adequately answered in the literature.

Functional outcomes and quality-of-life scores following hip resurfacing arthroplasty have been reported to be similar to those after conventional total hip replacement[39]. A prospective randomized trial reported by Lavigne, Girard et al (2007)suggested a slight increase in quality-of-life scores and activity levels in association with hip resurfacing arthroplasty[69]. Initial gait analyses of patients who had undergone hip resurfacing arthroplasty demonstrated confounding results, consisting of an increased peak abduction moment and decreased peak adduction moment. These findings were thought to lead to increased stresses in the femoral neck and predispose the patient to component loosening and femoral neck fracture. In a more recent paper, Mont et al. (2007) suggested, on the basis of gait analysis, that the results of hip resurfacing arthroplasty were superior to those of conventional hip replacement[70] (for example, walking was faster and hip kinematics were more normal).

In our study we observed that the return to function is excellent at short follow up. Of the ten patients, nine returned to gainful employment/studies and one patient who did not was incapacitated not by hip symptoms but by back pain.

Reports of apparent metal sensitivity-related failures suggest that a small number of patients have an allergic-type reaction to one or more of the constituent metals in their implant. This may be manifested as early unexplained pain (typically in the groin), effusions leading to enlarged bursae or groin masses, and periprosthetic osteolysis after two or three year. The issue of systemic toxicity and oncogenic potential of metal ions is not resolved. Langton, Jameson,. Joyce, et al. (2008) suggested that although there has been no proven link to long-term health problems or early prosthetic failure, variables associated with high metal ion concentrations should be identified and, if possible, corrected[71]. They also reported that accurate positioning of the acetabular component intra-operatively is essential in order to reduce the concentration of metal ions in the blood after hip resurfacing arthroplasty with the Articular Surface Replacement implant. In another study, Khan, Kuiper, and Richardson (2008) reported that the exercise-related cobalt rise was directly correlated with the inclination angle of the acetabular component and inversely correlated with the time since implantation and suggested that inclination of the acetabular component should be kept less than 40° to decrease the production of wear debris[72].

We observed acetabular inclination of 43.3^0 (range 25^0-65^0). Short term follow up did not show any adverse effect. We did not measure blood metal ions levels in our study.

We used posterior approach in all cases except one whom we used Ganz anterolateral approach. Both the approaches afforded adequate visualization of acetabulum.

One goal of hip resurfacing arthroplasty is to closely reproduce the normal anatomy of the proximal part of the femur and the hip joint, and it has been suggested that implant positioning may have a greater impact on implant survivorship and patient function than it does in a conventional hip replacement. It is generally recommended that surgeons strive for a relative valgus placement of 5° to 10° while avoiding notching of the superolateral cortex of the femoral neck[73,74]. The fact that some femoral necks naturally have a more varus orientation must be taken into account. Freeman was the first to emphasize the importance of a valgus orientation of the femoral component relative to the native femoral neck.

We observed a mean stem shaft angle of 140.5^0 (range 120^0- 150^0). Notching was not observed in any case. We did not observe fracture of neck of femur in any of the cases. The hip ratio was increased in three patients and decreased in two patients. No clinical correlation was noted at the short follow up.

Conclusion

SUMMARY AND CONCLUSIONS

The objective of our study was to evaluate the short-term clinical outcome after surface arthroplasty of the hip.

The clinical outcome was evaluated by the use of Harris Hip Score and the UCLA activity score. The post-operative assessment was done between five months and one year of the procedure.

We concluded that:

- The mean pre-operative Harris Hip Score was 48.5, while the mean post-operative Harris Hip Score was 93.9, indicative of the overall excellent short-term clinical outcome.
- The post-operative Harris Hip Score was between 80 and 90 in 1 out of 12 hips (8.33%), indicative of a good outcome and was between 91 and 100 in 11 out of 12 hips (91.67%), indicative of an excellent outcome.
- The improvement was confirmed by using other hip scoring systems viz UCLA Hip Score and Oxford Hip Score.
- Patients with inflammatory arthritis achieved lesser post operative range of flexion compared to the patients with non inflammatory arthritis. Interestingly the patients with inflammatory arthritis also achieved more increase in the Harris Hip Score compared to the non inflammatory group.

- There were no cases of post-operative wound infection or clinically manifest deep vein thrombosis.

We conclude that surface arthroplasty is a viable alternative to total hip arthroplasty, especially in young individuals, with excellent short-term clinical outcome.

As this is only a short term study, further follow up and evaluation with more number of patients is essential to come out with a definitive conclusion.

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Harris Hip Score

Synopsis of The Evaluation System

I. Pain (44 possible)

- A. None or ignores it 44
- B. Slight, occasional, no compromise in activities. 40
- C. Mild pain, no effect on average activities, rarely moderate pain with unusual activity, may take aspirin 30
- D. Moderate pain, tolerable but makes concessions to pain. Some limitation of ordinary activity or work. May require occasional pain medicine stronger than aspirin. 20
- E. Marked pain, serious limitation of activities. 10
- F. Totally disabled, crippled, pain in bed, bedridden 0

II. Function (47 possible)

A. Gait (33 possible)

1. Limp

- a. None 11
- b. Slight. 8
- c. Moderate 5
- d. Severe 0

2. Support

- a. None. 11
- b. Cane for long walks. 7
- c. Cane most of the time 5
- d. One crutch 3
- e. Two canes. 2
- f. Two crutches 0
- g. Not able to walk (specify reason). 0

B. Activities (14 possible)

1. Stairs

   a. Normally without using a railing 4
   b. Normally using a railing 2
   c. In any manner 1
   d. Unable to do stairs 0

2. Shoes and Socks

   a. With ease 4
   b. With difficulty 2
   c. Unable 0

3. Sitting

   a. Comfortably in ordinary chair one hour 5
   b. On a high chair for one-half hour 3
   c. Unable to sit comfortably in any chair 0

4. Enter public transportation 1

III. Absence of deformity points (4) are given if the patient demonstrates:

A. Less than 30° fixed flexion contracture
B. Less than 10° fixed adduction
C. Less than 10° fixed internal rotation in extension
D. Limb-length discrepancy less than 3.2 centimeters

IV. Range of motion (index values are determined by multiplying the degrees of motion possible in each arc by the appropriate index)

A. Flexion 0–45 degrees × 1.0
   45–90° × 0.6
   90–110° × 0.3
B. Abduction 0–15° × 0.8
   15–20° × 0.3
   over 20° × 0
C. External rotation in ext. 0–15 × 0.4
   over 15° × 0
D. Internal rotation in extension any × 0
E. Adduction 0–15° × 0.2

To determine the over-all rating for range of motion, multiply the sum of the index values × 0.05. Record Trendelenburg test as positive, level, or neutral.

UCLA Hip Rating

Pain

1. All the time; unbearable; strong medication frequently
2. All the time but bearable; strong medication occasionally; salicylates frequently
4. None or little at rest; with activities; salicylates frequently
6. When starting, then better, or after a certain activity; salicylates occasionally
8. Occasional and slight
10. No pain

Walking ability

1. Bedridden
2. Wheelchair; transfer activities with walker

4.	No support — housebound or One support — less than 1 block Bilateral support — short distances		Markedly restricted
6.	No support — less than 1 block One support — up to 5 blocks Bilateral support — unrestricted		Moderately restricted
8.	No support — limp One support — no limp		Mildly restricted
10.	No support or appreciable limp		Unrestricted

Function

1. Completely dependent and confined
2. Partially dependent
4. Independent; limited housework, limited shopping
6. Most housework, shops freely, desk-type work
8. Very little restriction; can work on feet
10. Normal activities

Activity

1. Wholly inactive: dependent on others; cannot leave residence
2. Mostly inactive: very restricted to minimum activities of daily living
3. Sometimes participates in mild activities
4. Regularly participates in mild activities such as walking, limited housework, and limited shopping
5. Sometimes participates in moderate activities
6. Regularly participates in moderate activities such as swimming and unlimited housework or shopping
7. Regularly participates in active events such as bicycling
8. Regularly participates in very active events such as bowling or golf
9. Sometimes participates in impact sports
10. Regularly participates in impact sports such as jogging, tennis, skiing, acrobatics, ballet, heavy labor, or backpacking